Experiences Using the Wireless FPD-Equipped MobileDaRt Evolution and Its Usefulness

Mr. Satoshi Yanagita

Department of Radiological Technology,
Kitasato University Kitasato Institute Medical Center Hospital
Satoshi Yanagita

1. Introduction

The Kitasato University Kitasato Institute Medical Center Hospital is a mid-sized community-based hospital **(Fig. 1)** that was built in 1989 on the former site of the agricultural experiment station in Kitamoto City, Saitama prefecture. In April 2008, the incorporated research center, Kitasato Institute, merged with the academic institution, Kitasato Gakuen, to form the Kitasato University Kitasato Institute Medical Center Hospital. Currently, the hospital offers 29 treatment departments with 372 beds.

In March 2011, our hospital introduced a Shimadzu MobileDaRt Evolution equipped with a wireless FPD, which has helped us provide good medical care so far. The following describes our experiences using the MobileDaRt Evolution, how we use it at our hospital, and its usefulness.

Fig. 1

2. Background of Introducing a MobileDaRt Evolution

Ever since the hospital was established, we have used a film screen system for general radiography, but due to the system getting old, we replaced it with CR and FPD systems in order to fully digitize all examinations. Compared to CR, FPD advantages include better image quality, faster displaying of results, fewer data entry errors and not requiring cassette replacement, enabling obtaining images with low exposure dose, faster examination throughput, and less deterioration over time. We have solicited help from manufacturers to try and find a way to use FPD for as much of our radiography needs as possible. Now that we have introduced several research and cassette type FPDs, such as long view radiography of full spine using an FPD and pelvimetry by martius method using an FPD, about 98 % of radiography in the general radiography department (including portable radiography at the patient wards and radiography in the operating rooms) is performed using FPDs.

In 1997, when FPDs were first available, the FPD sensor size, durability, power supply, and other issues did not permit portable radiography. After a portable cassette type FPD was released in 2001, FPD portable radiography started being used overseas. In 2004, our hospital started joint research with a manufacturer to introduce Japan's first mobile FPD system. Mobile FPD systems at that time had some disadvantages, such as a very heavy FPD unit (4.8 kg) and the FPD sensor was wired to the portable X-ray unit, which meant the connecting cable was often in the way. Nevertheless, due to the advantages of FPD, such as being able to view results quickly, which allows confirming the position of catheter tips and intubation tubes at the patient bedside, immediately after radiography, mobile FPD systems were very popular with physicians. In addition, the portable system allowed performing radiography until the battery charge was depleted, which significantly increased the number of images that could be obtain during a round of visits, compared to CR, and significantly decreased the work required by technologists to perform portable radiography. Then later, as a mobile FPD system was assigned

to the neurosurgery department for long-term dedicated use and other portable radiography systems were becoming old, we started considering introducing another mobile FPD system. As a result, we introduced a MobileDaRt Evolution in March 2011. Specifications for the older mobile FPD system introduced in 2004 and the new MobileDaRt Evolution system are shown in **Table 1**.

	 MobileDaRt Evolution with Wireless FPD	 Older Mobile FPD System
FPD	Canon CXDI-70C Wireless	Canon CXDI-50G
Detector	Scintillator & Amorphous Silicon (a-Si)	Scintillator & Amorphous Silicon (a-Si)
Scintillator	CsI	GOS (Gd2O2S: Tb)
Imaging area	35cm×43cm	35cm×43cm
Pixel size	125μm×125μm	160μm×160μm
Total pixels	2,800×3,408 (950Mpixels)	2,208×2,688 (590Mpixels)
Weight	3.4kg	4.8kg
Thickness	15mm	23mm
Cable length		7m

Table 1

3. Characteristics of the Wireless FPD-Equipped MobileDaRt Evolution

3.1 High Sensitivity

Fig. 2 shows the results from the CNR experiment we performed with the MobileDaRt Evolution and older mobile FPD system and indicates the method used. A 2 cm thick block of wood was placed on a 10 cm acrylic phantom as a high contrast signal and a 1 cm thick block of cork was placed as a low contrast signal. This configuration was measured using the MobileDaRt Evolution and older mobile FPD system at various exposure dose levels with tube voltage set to 75 kV. Then the CNR (contrast-to-noise ratio) was determined from resulting images. As shown in the CNR graph, equivalent image quality was obtained using less than half the dose, for both high and low contrast regions. This difference in sensitivity is due to the difference in the scintillator used in the FPD sensor. The FPD sensor on the MobileDaRt Evolution uses cesium iodide (CsI) scintillator, which provides higher luminance efficiency, whereas the FPD on the older mobile FPD system uses GOS (Gd202S: Tb). This difference means that the MobileDaRt Evolution is especially useful for applications sensitive to exposure dose levels, such as neonatal radiography in NICUs or portable chest radiography of pregnant women before emergency caesarean section.

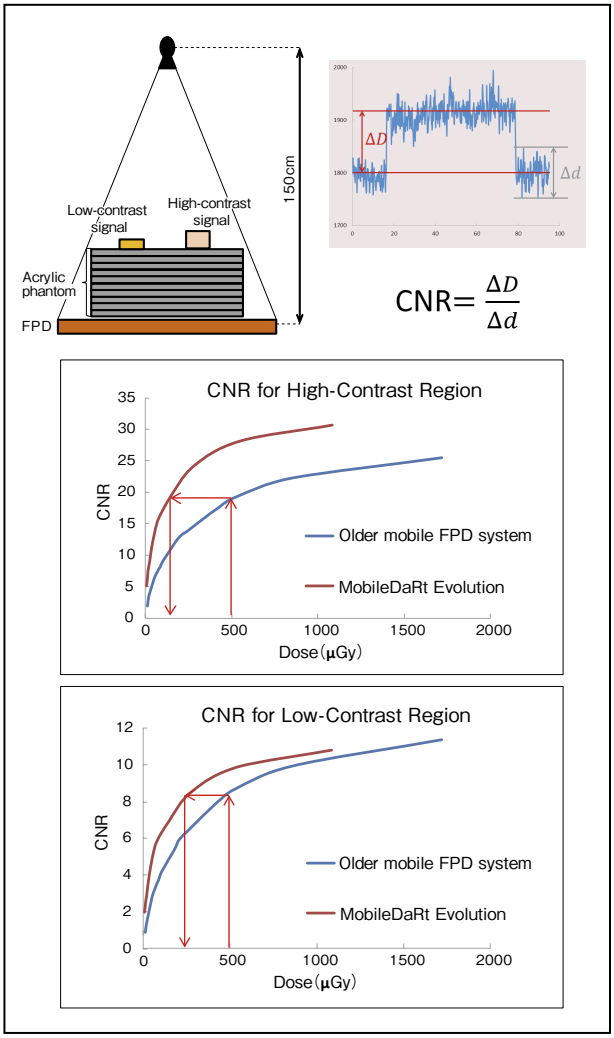


Fig. 2

3.2 Freedom of Use and Ease of Handling Cassette

Fig. 3 and Fig. 4 show the older FPD system and MobileDaRt Evolution, respectively, being used for a general chest radiography in a patient room. Because the older mobile FPD system is wired, it only allows approaching the patient to position the FPD from the side with the mobile unit, whereas the wireless MobileDaRt Evolution allows approaching the patient from either side of the bed. The wireless design also enables axial radiography of the hip joint or radiography of a fractured elbow during traction, in a convenient manner similar to CR. Furthermore, it minimizes interference with IV stands or respirators at the bedside, which means it can be used efficiently to save time, even in small private rooms. After performing radiography, it can also save time by eliminating the time required for stowing the cable after each examination.

Fig. 3

Fig. 4

3.3 High Resolution for Displaying Images

Fig. 5 shows the display screen and resolution of the MobileDaRt Evolution and older mobile FPD system. The resolution on the older mobile FPD system is 640 × 480 pixels, but the MobileDaRt Evolution resolution is 1024 × 768 pixels. As mentioned above, portable radiography is often used to confirm the position of catheter tips and intubation tubes. Therefore, higher resolution is better.

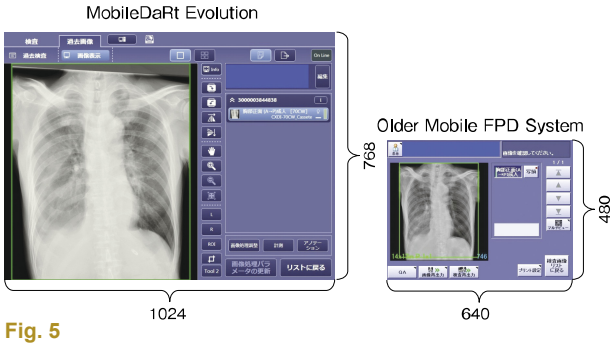


Fig. 5

3.4 Function to Reference Past Images

The MobileDaRt Evolution stores a history of past images on a hard disk drive. At our hospital, depending on settings, it saves about 20 GB of image history (equivalent to about 1333 14 × 17-inch images at 15 MB per image). These can be referenced even during examinations to ensure high reproducibility.

4. Achieving Paperless Portable Radiology for Rounds

Normally, using portable radiography on rounds usually involves printing out a summary list of order information for patients scheduled to be visited or printing out order form for each individual patient before leaving on rounds. In recent years, some facilities have installed RIS functionality in a notebook computer or PDA device, and then carry that device along on rounds.

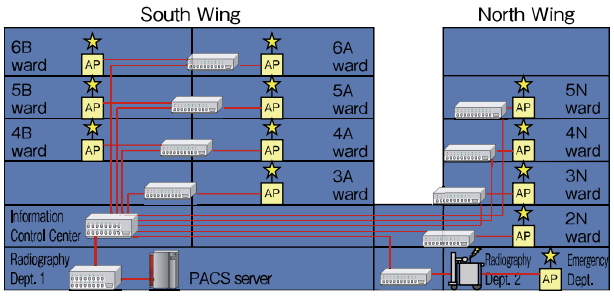
In our hospital, we do not use notebook computers or PDA terminals, but rather we use the MobileDaRt Evolution in a paperless system of portable radiography rounds. The RIS uploads a list file of patients scheduled for rounds to the MWM server and simultaneously sends an HIS received status to disable order changes during rounds. The MobileDaRt Evolution obtains the list of patients scheduled for rounds from the MWM server. By using the unused DICOM tag to write information necessary for rounds, the MobileDaRt Evolution is able to display all information necessary

for rounds on the patient summary list screen. The MobileDaRt Evolution patient summary list screen is shown in Fig. 6.

Fig. 6

5. Transferring Images Wirelessly to PACS

Our hospital has set up the HIS network as a VLAN and has installed dedicated radiology network access points in each hospital wing. A wireless LAN is used to transfer image data acquired with the MobileDaRt Evolution to the PACS via DICOM communication (Fig. 7). The 5 GHz band IEEE 802.11a wireless protocol is used, so there is no worry about a drop in transfer speed due to interference with the 2.4 GHz band IEEE 802.11n protocol used for the wireless FPD. WPA-PSK encryption (AES encryption mode) is used for security. This wireless LAN can be used to transfer images directly from the bedside to the PACS. As a result, images can be referenced via the PACS as soon as an examination is finished, even while still out on rounds. Even if an order is added while out on rounds, the MWM server can be contacted from patient ward areas to obtain a list.



Access Point Locations: One in each hospital ward and one at the mobile FPD unit storage area, for a total of 12 units

Fig. 7

6. Comparison of Workflow with Portable CR and Older Mobile FPD Systems

A comparison of the workflow involved in using a portable CR unit, older mobile FPD system, and MobileDaRt Evolution is shown in Fig. 8. Using the CR unit involves printing out the radiography order, transporting the cassette, reading a barcode, transferring patient information, and reading the imaging plate, but the older mobile FPD system does not require any of those steps. The MobileDaRt Evolution additionally eliminates the process of stowing the cable after performing radiography, which means it requires less work and time to perform radiography rounds than the portable CR unit or mobile FPD system.

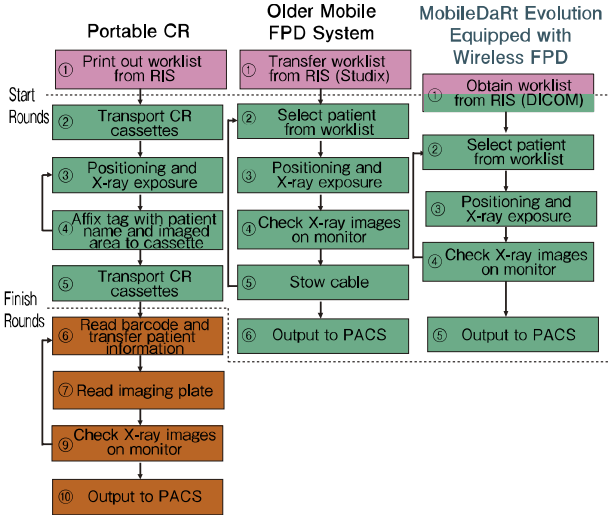


Fig. 8

7. Additional Uses for MobileDaRt Evolution

At our hospital, the older mobile FPD system is connected to a high definition external monitor and used during spinal surgery in the neurosurgery department to confirm the location of excised parts, to confirm the location of screw insertion, and so on. Because the older mobile FPD system includes an FPD cable, the FPD sensor itself cannot be used in clean environments. Therefore, it must be fastened directly below the surgery table or between the patient and surgery table and can only be used for frontal radiography. Since the MobileDaRt Evolution FPD sensor is wireless, it can also be used for lateral radiography by wrapping it in a sterile sheet or enclosing in a sterile bag. Therefore, it allows navigating surgical procedures more accurately (Fig. 9).

Fig. 9

8. Summary

Introducing the MobileDaRt Evolution equipped with a wireless FPD has significantly changed the workflow of going on rounds in the hospital and allows performing the work more efficiently. The high-sensitivity FPD makes us expect a further reduction of exposure dose levels below previous FPD-equipped portable systems. In addition, the ability to display results with high resolution and distribute images using the internal wireless LAN during rounds enables quickly providing information to physicians and effectively results in providing higher quality medical care to patients.

Though many advantages of the wireless FPD-equipped MobileDaRt Evolution are noted above, to take full advantage of its capabilities, it is important we clinical radiologists thoroughly review specification, design, and operational requirements before introducing the system, such as by preparing the hospital's infrastructure, obtaining consensus from department in charge of information systems, customizing the RIS, reviewing the process of hospital rounds.